NPOESS – Global Data for the Global Observation System

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The Aerospace Corporation

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NPOESS MISSION

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- **Not just a "Weather" satellite, also provides climate quality data**
- Evolutionary move from today to support emerging science (NWP, etc)
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NPOESS Requirements

Convergence of Alternatives

Integrated Operational Requirements Document (IORD-I)

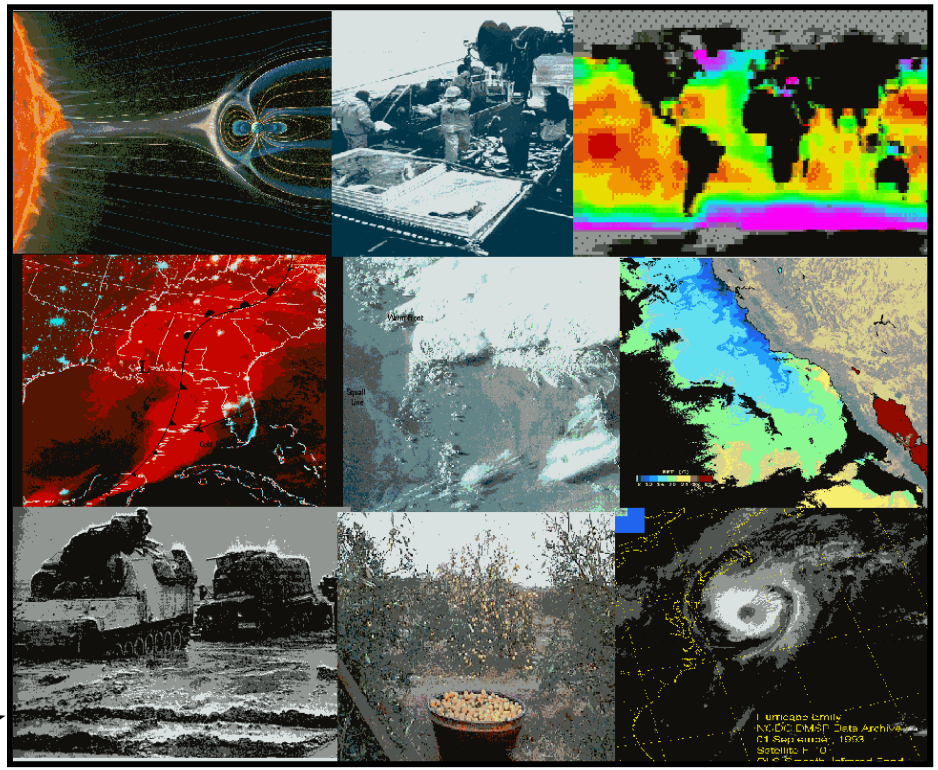
- 59 Data Products
- 9 Enhancement Products
- 1 System Characteristic KPP

Validated by JARC 1996

IORD-II

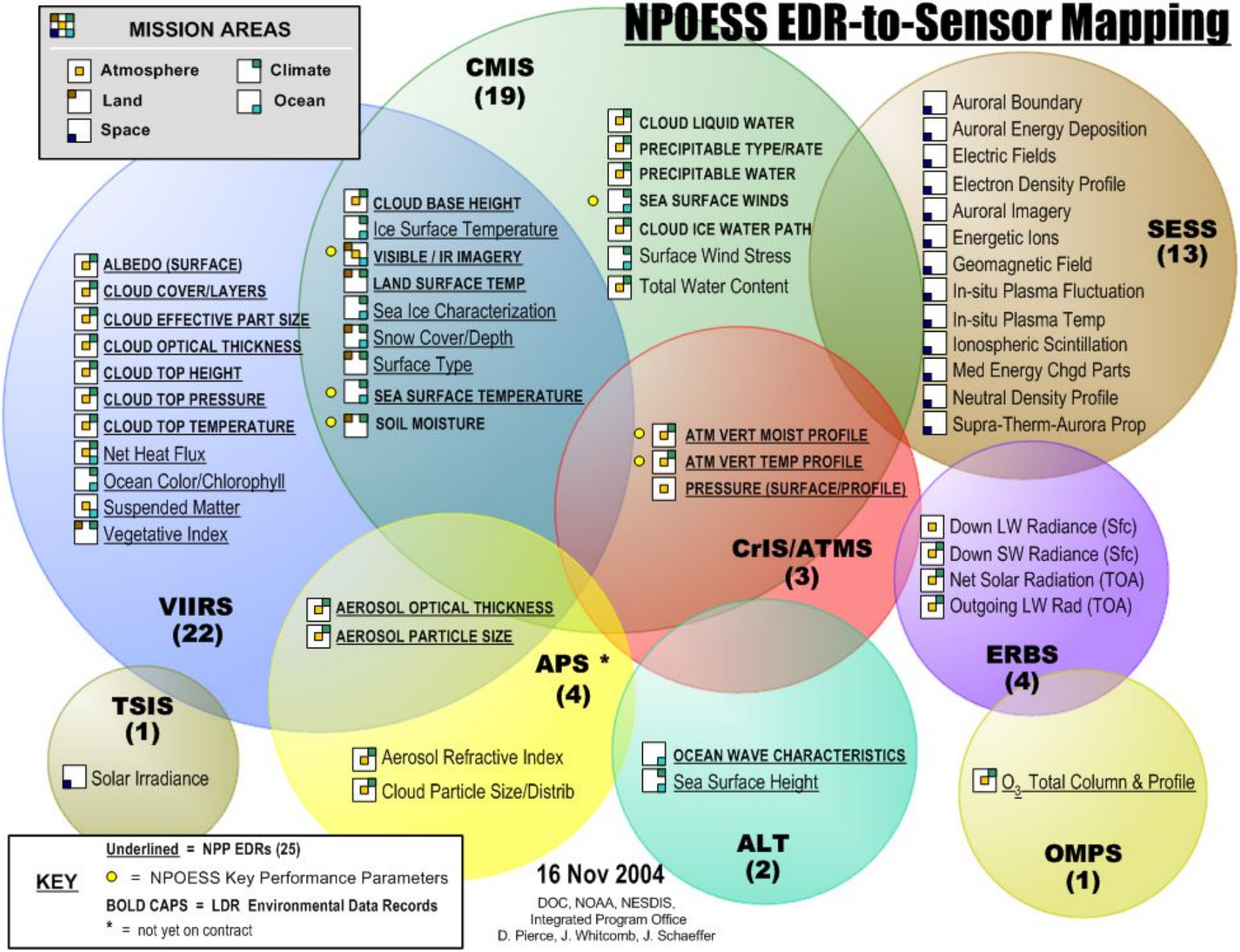
- 55 Data Products
- 21 Enhancement Products
- 2 System Characteristic KPPs

Validated by JARC Dec 2001



Convergence of Requirements

Converged Requirements Provide Foundation for Combined Program


NPOESS EDR-to-Sensor Mapping
MISSION AREAS
Atmosphere
Climate
Land
Ocean
Space
CMIS
(19)
CLOUD LIQUID WATER
PRECIPITABLE TYPE/RATE
PRECIPITABLE WATER
SEA SURFACE WINDS
CLOUD ICE WATER PATH
Surface Wind Stress
Total Water Content
CLOUD BASE HEIGHT
Ice Surface Temperature
VISIBLE / IR IMAGERY
LAND SURFACE TEMP
Sea Ice Characterization
Snow Cover/Depth
Surface Type
SEA SURFACE TEMPERATURE
SOIL MOISTURE
SESS
(13)
Auroral Boundary
Auroral Energy Deposition
Electric Fields
Electron Density Profile
Auroral Imagery
Energetic Ions
Geomagnetic Field
In-situ Plasma Fluctuation
In-situ Plasma Temp
Ionospheric Scintillation
Med Energy Chgd Parts
Neutral Density Profile
Supra-Therm-Aurora Prop
ALBEDO (SURFACE)
CLOUD COVER/LAYERS
CLOUD EFFECTIVE PART SIZE
CLOUD OPTICAL THICKNESS
CLOUD TOP HEIGHT
CLOUD TOP PRESSURE
CLOUD TOP TEMPERATURE
Net Heat Flux
Ocean Color/Chlorophyll
Suspended Matter
Vegetative Index
VIIRS
(22)
ATM VERT MOIST PROFILE
ATM VERT TEMP PROFILE
PRESSURE (SURFACE/PROFILE)
CrIS/ATMS
(3)
Down LW Radiance (Sfc)
Down SW Radiance (Sfc)
Net Solar Radiation (TOA)
Outgoing LW Rad (TOA)
ERBS
(4)
AEROSOL OPTICAL THICKNESS
AEROSOL PARTICLE SIZE
APS *
(4)
TSIS
(1)
Solar Irradiance
Aerosol Refractive Index
Cloud Particle Size/Distrib
OCEAN WAVE CHARACTERISTICS
Sea Surface Height
ALT
(2)
O3 Total Column & Profile
OMPS
(1)
KEY
Underlined = NPP EDRs (25)
= NPOESS Key Performance Parameters
BOLD CAPS = LDR Environmental Data Records
* = not yet on contract
16 Nov 2004
DOC, NOAA, NESDIS,
Integrated Program Office
D. Pierce, J. Whitcomb, J. Schaeffer

Integrated Operational Requirements Document (IORD) Example

Sea Surface Temperature (SST)

Highly precise measurement of the temperature of the surface layer (upper 1 meter) of ocean water

Systems Capabilities	Thresholds	Objectives
a. Horizontal Cell Size		
Nadir, clear	1 km	0.25 km
Worst case, clear	1.3 km	
All Weather	40 km	20 km
b. Mapping Accuracy		
Nadir, clear	1 km	0.1 km
Worst case, clear	1.3 km	
All Weather	5 km	3 km
c. Measurement Range	-2° to 40° C	-2° to 40° C
d. Measurement Precision		
Clear	0.2° C	0.1° C
All Weather	0.3 ° C	0.1 ° C
e. Measurement Uncertainty		
Clear	0.5° C	0.1° C
All Weather	1.0 ° C	0.5 ° C
f. Refresh	6 hours	3 hours
g. Long-Term Stability	0.1° C	.05° C
h. Latency	90 minutes	15 minutes
i. Geographic Coverage	Global Ocean	Global Ocean

apply only under clear conditions (unless specified otherwise)

Major Applications

1) **sea surface phenomenology**
2) **infrared cloud / no cloud decision for processed cloud data**

Iterative, Disciplined Requirements Process Ensures Users Needs Met

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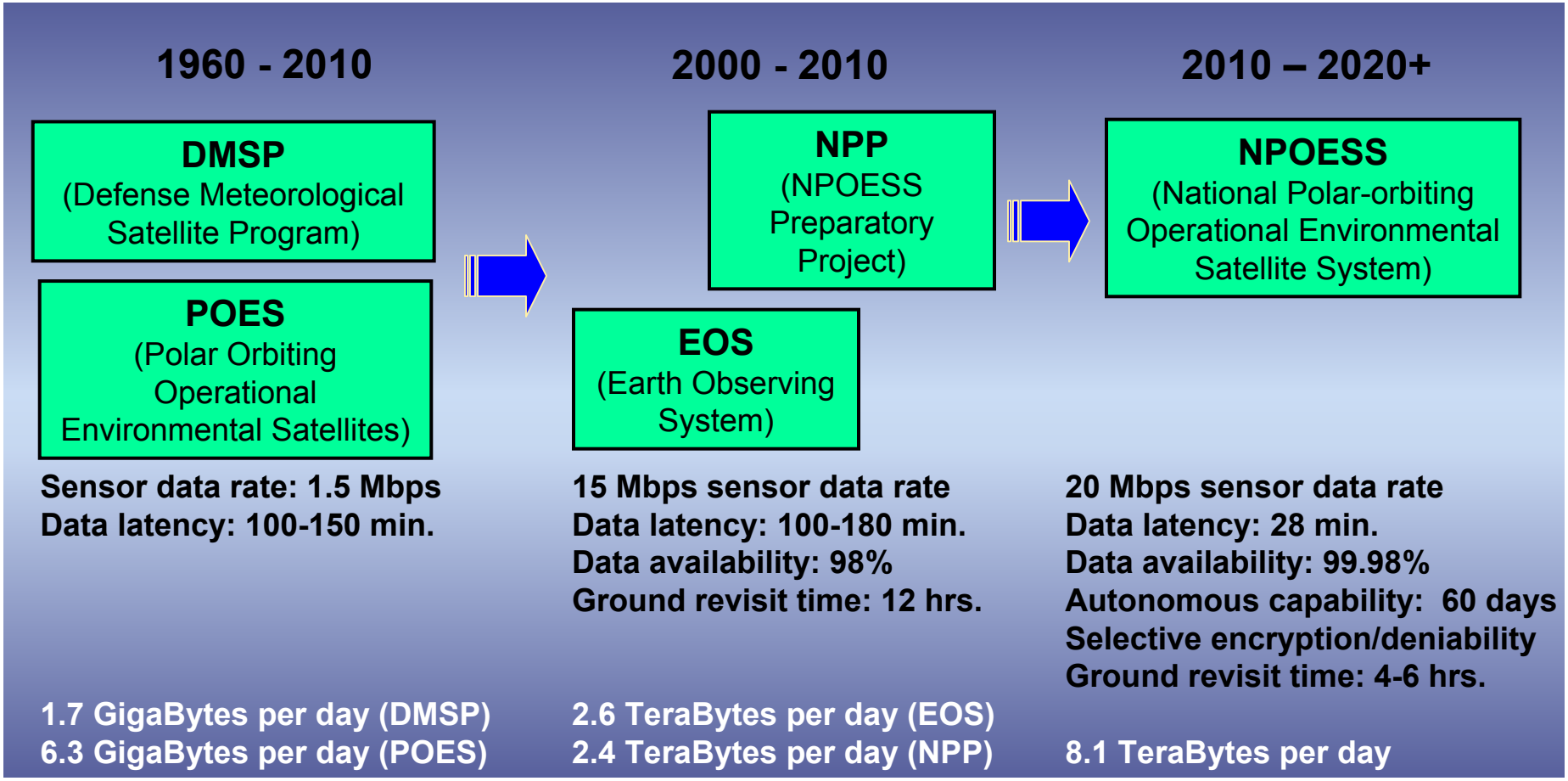
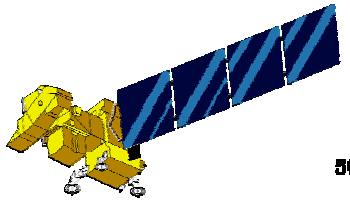
Evolutionary Roadmap

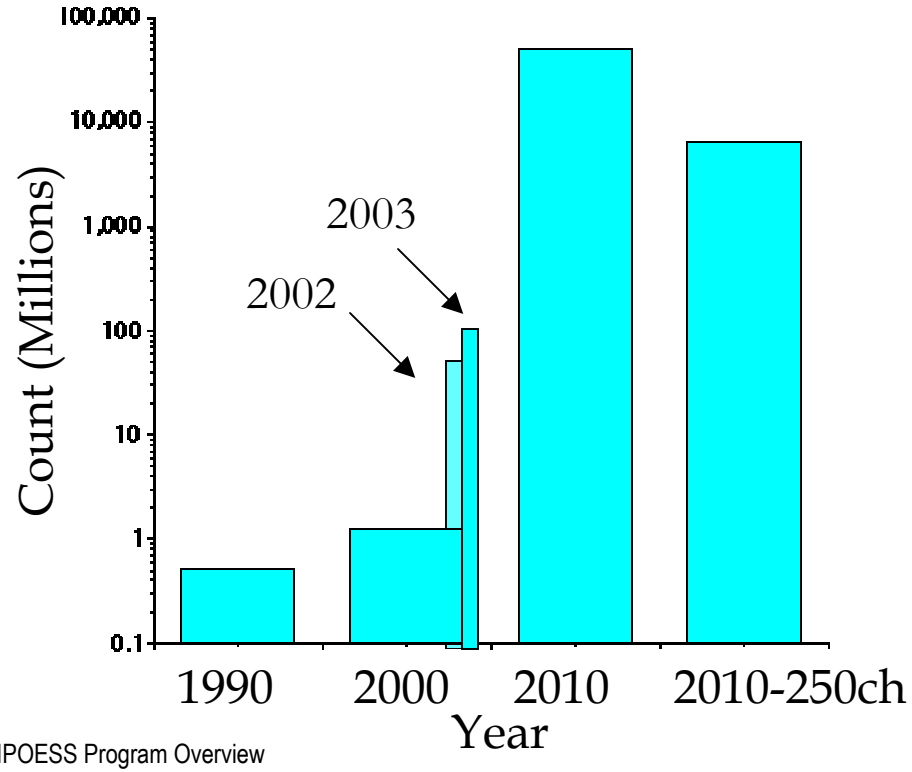


NPOESS Satisfies Evolutionary Program Needs with Enhanced Capabilities

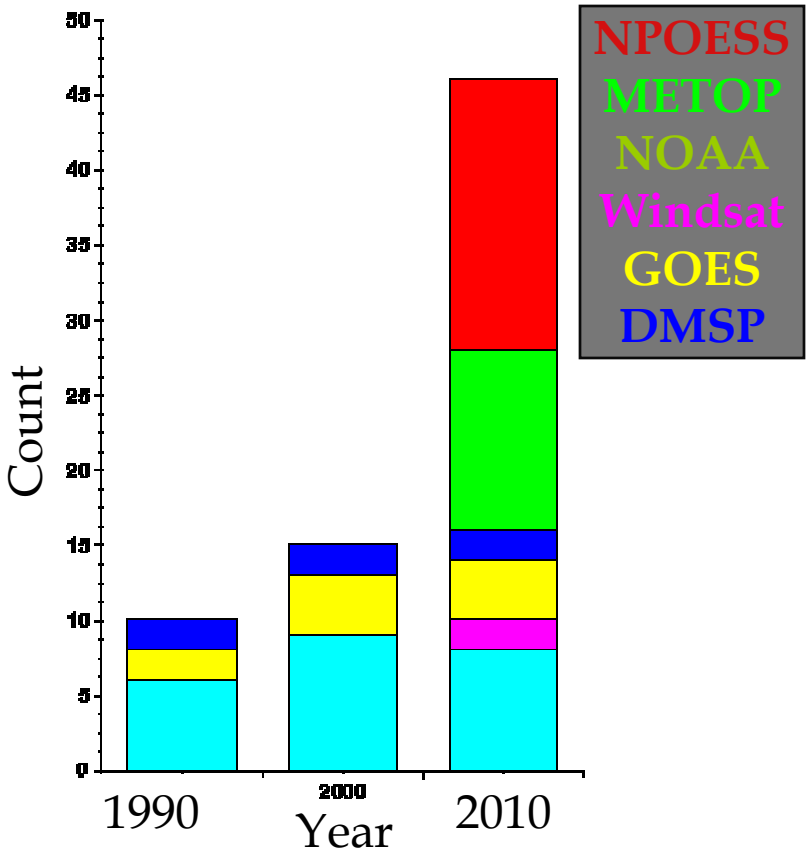
5-Order Magnitude Increase in Satellite Data Over 10 Years

Daily Upper Air Observation Count



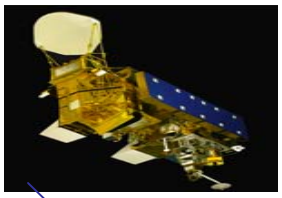


Satellite Instruments by Platform



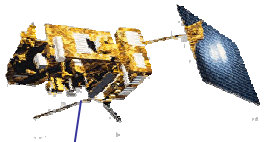
Real-Time Operational Demonstrations

Aqua (2002)
AIRS/AMSU/HSB & MODIS

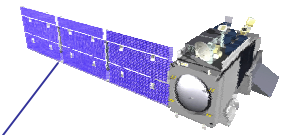


Coriolis
WindSat (2003)

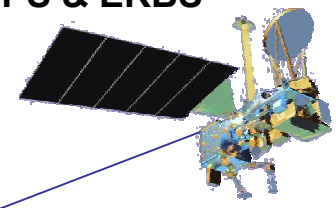
METOP (2005)
IASI/AMSU/MHS & AVHRR



NPP (2006)
CrIS/ATMS
VIIRS
OMPS



NPOESS (2009)
CrIS/ATMS, VIIRS, CMIS,
OMPS & ERBS



Use of Advanced Sounder Data for Improved Weather Forecasting/Numerical Weather Prediction

NOAA Real-Time Data Delivery Timeline Ground Station Scenario

C3S → IDPS → NOAA Real-time User

Joint Center for Satellite Data Assimilation

NWS/NCEP
GSFC/DAO
ECMWF
UKMO
FNMOC
Meteo-France
BMRC-Australia
Met Serv Canada

→ NWP Forecasts

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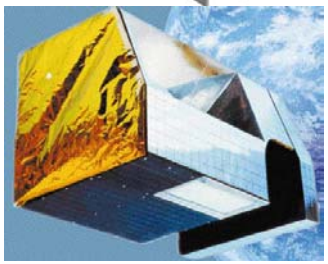
Development Sensor Highlights

Visible/Infrared Imager Radiometer Suite (VIIRS) (Supports 22 EDRs)

Raytheon Santa Barbara Prototype in assembly/qual, flight unit in production

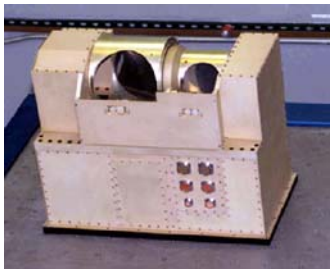
- 0.4 km imaging and 0.8 km radiometer resolution
- 22 spectral bands covering 0.4 to 12.5 μm
- Automatic dual VNIR and triple DNB gains
- Spectrally and radiometrically calibrated
- EDR-dependent swath widths of 1700, 2000, and 3000 km



Crosstrack InfraRed Sounder (CrIS) (Supports 3 EDRs)

ITT Ft Wayne Prototype in qualification, flight unit in production

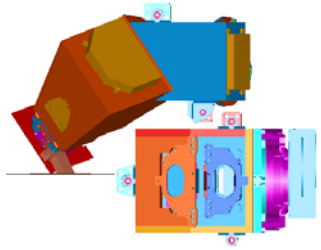
- 158 SWIR (3.92 to 4.64 μm) channels
- 432 MWIR (5.71 to 8.26 μm) channels
- 711 LWIR (9.14 to 15.38 μm) channels
- 3x3 detector array with 15 km ground center-to-center
- 2200 km swath width



Advanced Technology Microwave Sounder (ATMS) - NASA (Supports 3 EDRs)

Northrop Grumman Electronics Flight unit in protoqual

- CrIS companion cross track scan
- Profiling at 23, 50 to 57, 183 GHz
- Surface measurements at 31.4, 88, 165 GHz
- 1.1, 3.3, and 5.2 deg (SDRs resampled)
- 2300 km swath width

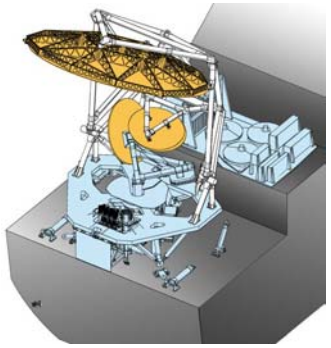


Ozone Mapping and Profiler Suite (OMPS) (Supports 1 EDR)

Ball Aerospace Flight unit in production

- Total ozone column 300 to 380 nm with 1.0 nm resolution
- Nadir ozone profile 250 to 310 nm with 1.0 nm resolution
- Limb ozone profile 290 to 1000 nm with 2.4 to 54 nm resolution
- Swath width of 2800 km for total column

Development Sensor Highlights (cont.)

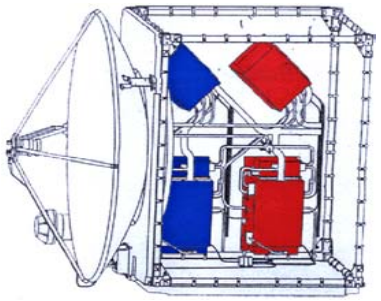


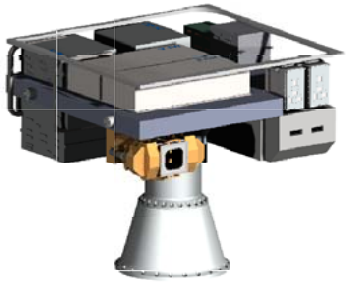
Conical Scanning Microwave Imager/Sounder (CMIS) (Supports 19 EDRs)

Boeing Space Systems Delta PDR complete

- 2.2 m antenna
- RF imaging at 6, 10, 18, 36, 90, and 166 GHz
- Profiling at 23, 50 to 60, 183 GHz
- Polarimetry at 10, 18, 36 GHz
- 1700 km swath width
- Radio Interference (RFI) ECP complete, negotiations being wrapped up

Leverage Sensor Highlights





Radar Altimeter (ALT) (Supports 3 EDRs)

Alcatel

- Measures range to ocean surface with a radar at 13.5 GHz
- Corrects for ionosphere with 5.3 GHz radar
- Corrects for atmosphere with CMIS water vapor measurements
- Precise orbit determination with GPS

Earth's Radiation Budget Suite (ERBS) (Supports 4 EDRs)

Northrop Grumman Space Technology

- Three spectral channels
- Total radiation measurement 0.3 to 50 μm
- Shortwave Vis and IR measurement 0.3 to 5 μm
- Longwave IR measurement 8 to 12 μm

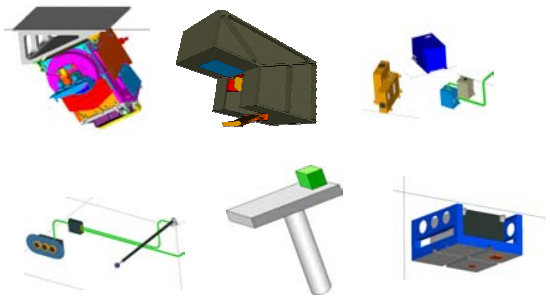
Total Solar Irradiance Sensor (TSIS) (Supports 1 EDR)

University of Colorado Agreements in place, design underway

- Two sensors for total irradiance (TIM) & spectral irradiance (SIM)
  - TIM measures total solar irradiance
  - SIM measures spectral irradiance 200 to 2000 nm
- Pointing platform and sensor suite to be provided by CU LASP

Survivability Sensor (SS)

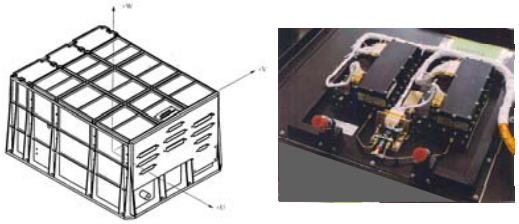
Highlights of Other Sensors



Space Environment Sensor Suite (SESS) (Supports 13 EDRs)

Ball Aerospace Final instrument suite being selected, ECP in negotiations

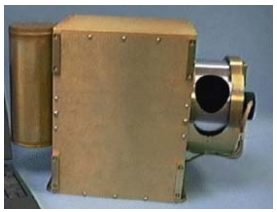
- Sensor suite collecting data on particles, fields, aurora, and ionosphere
- Suite includes a UV disk imager (BATC), charged particle detectors (Amptek/U. of Chicago), thermal plasma sensors (UTD)
- Will distribute suite on all 3 orbital planes



Advanced Data Collection System (ADCS) and Search and Rescue Satellite-Aided Tracking (SARSAT)

ITAR approved licenses in place, first integration TIMs underway

- "GFE" to NPOESS from France and Canada
- ADCS supports global environmental applications
- SARSAT collects distress beacon signals



Aerosol Polarimetry Sensor (APS) (Supports 4 EDRs)

Raytheon Santa Barbara Research Center Full development on hold pending NASA satellite "Glory" plans

- Aerosol characterizations of size, single scattering albedo, aerosol refractive index, aerosol phase function
- Multispectral (broad, 0.4 to 2.25 μm)
- Multiangular (175 angles)
- Polarization (all states)

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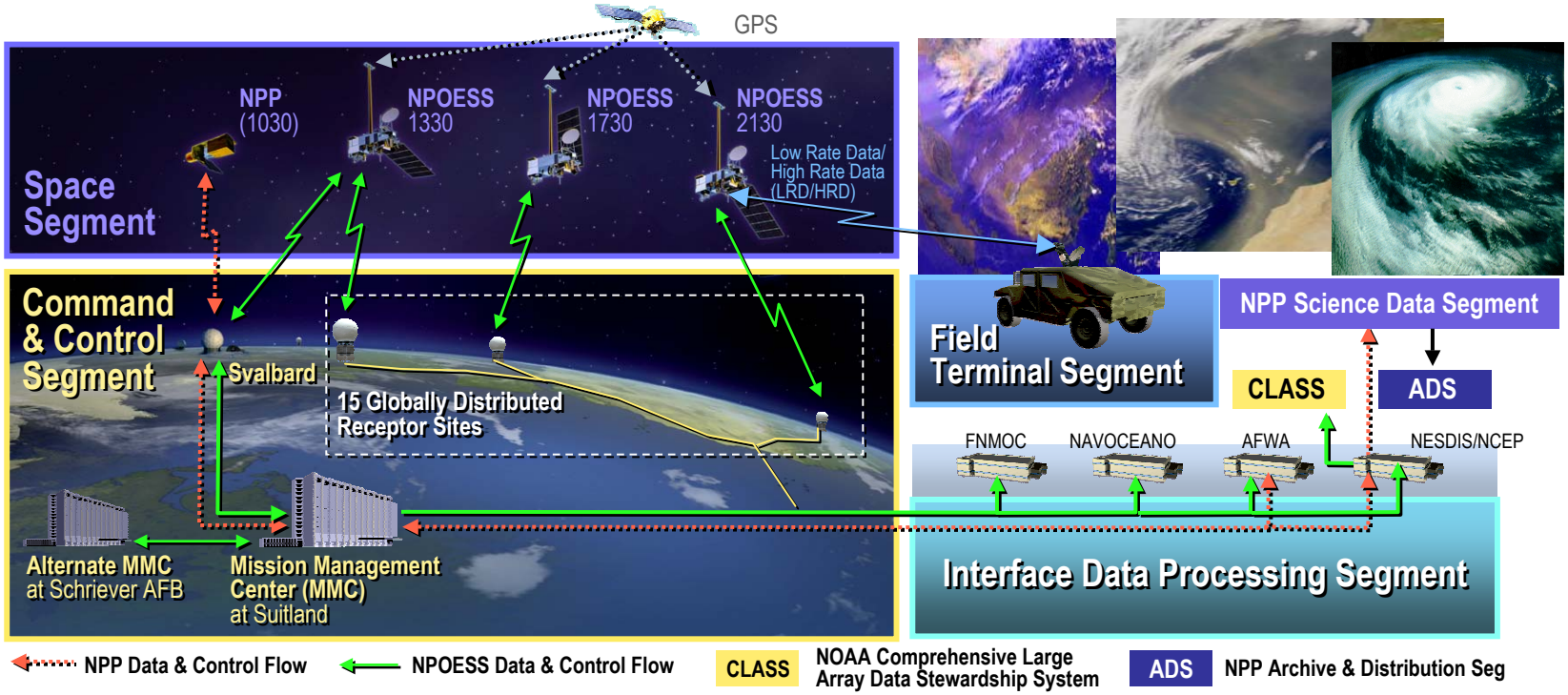
NPOESS Top Level Architecture

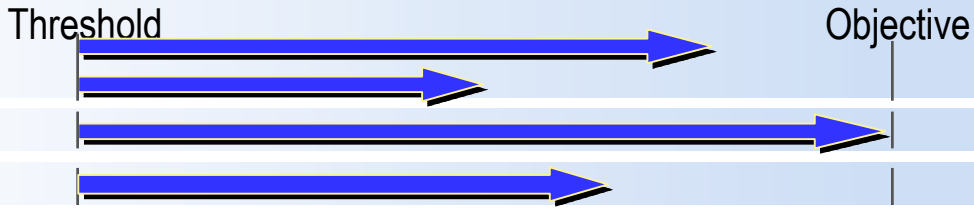


Data Quality
SMD/HRD — 128 attributes above, 724 at, 7 below threshold
LRD — 305 attributes above, 180 at, 0 below threshold

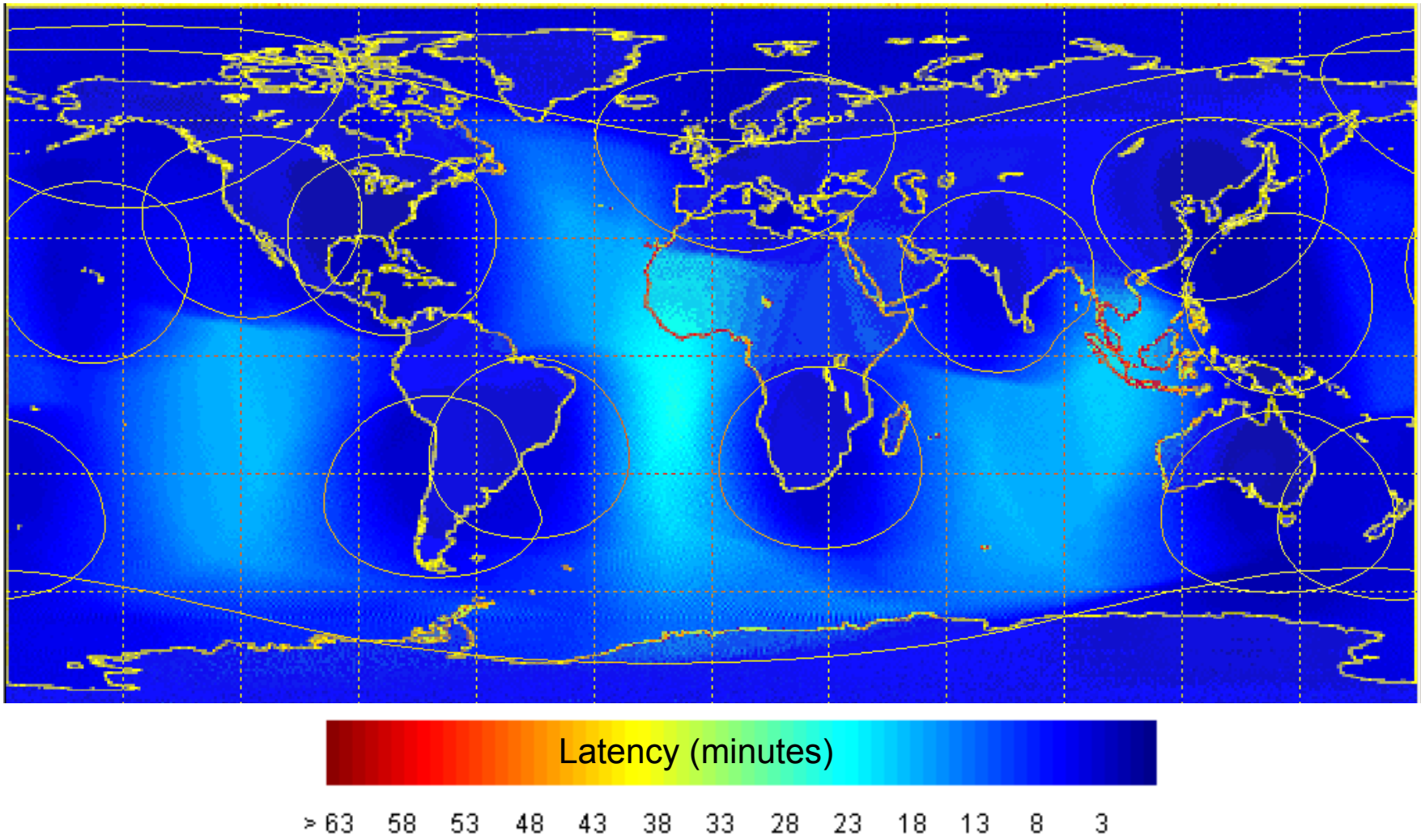
Data Latency
SMD
HRD/LRD

Data Availability

Operational Availability



Average Data Latency



SUMMARY

A sample of NPOESS data will be available in late 2006 from NPP

NPOESS launches in late 2009

- Operational after 12-18 month cal/val (varies by sensor)
- Expect all three orbits filled by 2013

Data will be available to all

- Real time data from direct downlink sent in the clear
- Processing software will be available to all
  - No cost other than media and shipping
  - No cost if downloaded from the net

NPOESS will provide higher quality data in a more timely manner

For more information see www.npoess.noaa.gov